CLAIMS

1. A quasi-periodic echelle grating structure for use in an optical device to achieve a desired narrow-band optical transfer function, which is the Fourier transform of the desired impulse response; the structure comprising:

a plurality of contiguous reflective grating facets, the nominal spacing of which corresponds to a desired free spectral range, and the number of said facets being selected based upon the desired spectral resolution of said transfer function;

each said facet having a size corresponding to an amplitude of said impulse response coefficient at a selected delay; and

each said facet having a position corresponding to a phase of said impulse response coefficient at a selected delay.

2. The echelle grating structure recited in claim 1 wherein said structure is replicated from a master.

3. The echelle grating structure recited in claim 1 wherein each said facet is coated for increased reflectivity.

4. An optical system for realizing a selected transfer function for narrow-band incident optical signals; the system comprising:

entrance and exit apertures which are spatially single-mode over a wavelength range of interest;

an echelle structure having a selected number of reflective facets, the nominal spacing, the number of facets, the size of each facet and the position of each facet being selected to approximate said selected transfer function; and

at least one collimator for collimating said optical signals onto said echelle structure.

5. The optical system recited in claim 4 wherein at least one of said entrance and exit apertures comprises a single-mode optical fiber.

6. The optical system recited in claim 4 further comprising a single-mode slab waveguide which confines said optical signals in at least one direction and wherein said echelle structure is formed in an edge of said slab waveguide.

7. An optical filter having a selected arbitrary narrow-band impulse response; the filter comprising:

entrance and exit apertures which are spatially single mode over the selected filter bandwidth;

an echelle structure having a selected number of reflective facets, the nominal spacing, the number of facets and their respective sizes and positions being selected to approximate said selected transfer function; and

at least one collimator for collimating light signals onto said echelle structure.

8. The optical filter recited in claim 7 wherein at least one of said entrance and exit apertures comprises a single-mode optical fiber.

9. The optical filter recited in claim 7 further comprising a single-mode slab waveguide which confines said optical signals in at least one direction and wherein said echelle structure is formed in an edge of said slab waveguide.

10. A method of fabricating an echelle grating structure for use in an optical device to achieve a desired narrow-band optical transfer function; the method comprising the steps of:

a) determining the nominal grating spacing of said echelle structure based on the free spectral range FSR of the desired narrow-band optical transfer function;

b) determining the minimum number of echelle facets M based upon the free spectral range FSR of the optical device and the desired spectral resolution W of the response of the optical device, where $M = \frac{FSR}{W}$ rounded up to the nearest integer;

c) expressing the desired optical impulse response as the inverse Fourier-transform of the desired optical transfer function;

d) setting the size of each said facet based upon the amplitude of the corresponding impulse response coefficient; and

e) setting the precise position of each said facet, as a perturbation from the nominal grating spacing, based upon the phase of the corresponding impulse response coefficient.